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(54) **Axial piston pump**

Axialkolbenpumpe

Pompe à pistons axiaux

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- **PATENT ABSTRACTS OF JAPAN vol. 10, no. 342 (M-536) (2398) 19 November 1986 & JP-A-61 144 423**

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Description

The present invention relates to an axial piston pump of the type generally used in hydraulic systems.

A conventional axial piston pump comprises a rotating cylinder block which is supported on a drive shaft which is, in turn, supported on bearings, to enable the shaft and cylinder block to rotate together. The block contains a plurality of pistons. Each piston is fitted, by means of a universal joint, with a slipper pad. The slipper pads contact and react against a load surface of a swashplate which surrounds the drive shaft. The load surface is inclined at an angle to the axis of rotation of the drive shaft.

The swashplate is held stationary in relation to the rotating cylinder block. Therefore, the action of the slipper pads against the angled load face of the swashplate causes a reciprocating action in the pistons.

The reciprocation of the pistons causes oil to be drawn into the cylinder via an inlet port located in the pump housing, a kidney-shaped inlet port situated in a valve plate located between the cover and an opposed, adjacent valve face of the cylinder block. The valve face of the cylinder block and the opposed face of the valve plate lie in a plane perpendicular to the rotational axis of the drive shaft.

The oil is discharged via slots in the valve face of the cylinder block and on through a kidney-shaped outlet port in the valve plate. This discharged oil is subsequently directed through loading pistons housed within the cover and finally on through an outlet port provided in the cover.

The pump design must ensure that clearance between valve plate and cylinder block face is controlled in order to minimise leakage without incurring excessive frictional losses.

This controlled clearance can be achieved in two ways. The first method has the valve plate rigidly mounted to the pump casing with the cylinder block connected to the drive shaft by a loose fitting spline. The main pumping pistons load the cylinder block hydrostatically against the valve plate. The clearance in the spline allows the cylinder block to articulate, thus accommodating manufacturing tolerances and deflections arising from the loads generated within the pump. This articulation facilitates the alignment of the cylinder block valve face and the valve plate. Such a conventional pump is shown in accompanying figures 7a and 7b.

US 2 241 701 discloses a fluid pressure energy translating device which can be used as a pump. In this device an axially displaceable cylinder block is urged against a static valve plate. To accommodate fluctuations in the axial position of the cylinder block the ports in the valve plate are provided with perimeteral seals which are urged against the cylinder block. Due to the arcuate shape of the ports, these seals are arcuate also.

EP-A-175 206 discloses a similar arrangement.

The second configuration has the cylinder block rigidly mounted to the drive shaft and the valve plate is floating in the axial direction. The valve plate is loaded against the cylinder block by a series of loading pistons. The second arrangement affords the advantage that the low inertia valve plate can follow the cylinder block runnout with minimum vibration. The higher inertia of the floating cylinder block version leads to high amplitude vibrations and consequently the valve plate clearance in adversely affected.

In a floating valve plate pump, the loading pistons are used to load the valve plate onto the cylinder block in the axial direction of the shaft and are designed to prevent separation of the porting interface valve face, thereby minimising a loss of pressurized fluid into the pump casing.

The displacement of the pump can be varied from zero to a maximum by altering the angle of the swashplate using, for example, control pistons situated within the pump housing. The control system, for controlling the angle of the swashplate, requires that the friction between a rear, curved side of the swashplate and a complementary, but inversely, curved swashplate cradle (which seats the swashplate) be kept to a minimum. This can be achieved by means of a hydrostatic bearing system which is supplied with lubricating oil at a pump outlet pressure. Alternatively, a roller bearing can be used, but this feature has the disadvantages of high cost, increased noise level and limited life.

Although such pumps have been widely used, they do have short-comings related to efficiency, reliability and cost which the invention addresses.

The valve plate provides a mechanism for transferring fluid to and from the cylinder block. It is important to maintain the design clearance between the valve plate and cylinder block in order to optimize leakage and frictional losses. If loading is excessive, it results in seizure between the static valve plate and the rotating cylinder block.

To date, the valve plate has been loaded against the cylinder block by four (for example) circular loading pistons (DE-B-1 653 565 illustrates a machine with circular loading pistons). Each of the discrete pistons imparts a localised load onto the valve plate. This results in distortion of the valve plate, leading to undesirable variation in the clearance between the valve plate and the cylinder block and in the extreme, metal to metal contact can occur. In areas of high clearance leakage increases and the pump's efficiency is reduced. Areas of low clearance increase the risk of seizure and the pump's reliability is adversely affected at extreme operating conditions.

The conventional way of providing the hydrostatic low friction bearing between the rear of the swashplate and the swashplate cradle requires a feed of high pressure oil from the pump outlet port. This has conventionally been achieved by means of a series of interconnecting drillings from the outlet port at one end of the pump, via the pump casing, to the swashplate bearing which

is at the opposite end of the pump to the outlet port. The drilling provided in the pump casing is complicated and relatively expensive to manufacture.

The present invention sets out to provide an axial piston pump in which the leakage gap between the cylinder block and the valve plate is minimised but without causing seizure or excessive frictional losses.

Furthermore, the invention sets out to provide an arrangement in which distortion of the valve plate is obviated or mitigated, thereby avoiding local variations in the thickness of the oil film between the valve plate and the cylinder block.

According to the invention there is provided an axial piston pump comprising a drive shaft (2), a cylinder block (4) fixed to, and rotatable with, the drive shaft (2), a plurality of first pistons (6a-6i) provided within the cylinder block (4), a swashplate (12) situated at one axial end of the cylinder block (4) for causing reciprocation of the pistons (6a-6i) when the said cylinder block (4) is rotated, and an axially moveable valve plate (26) situated at a second axial end of the cylinder block (4) and held stationary relative to the direction of rotation of the cylinder block (4) and urged against the said second end of the cylinder block (4) to form a hydrostatic seal between the cylinder block (4) and a bearing face (52) of the said valve plate (26) which addresses the cylinder block, wherein the valve plate (26) is urged against the cylinder block (4) by means of a second piston (60), the said second piston (60) having a load face which is axially aligned with a portion of the said bearing face (52) of the valve plate; characterised in that the said load face of second piston (60) is arcuate.

By adopting a single piston, the valve plate loading becomes evenly distributed, resulting in less distortion of the valve plate. As a result of this reduction in distortion of the valve plate, local distortions in the oil film thickness caused by using discrete pistons can be avoided, providing less leakage, minimum friction and higher reliability. Because the valve plate distributes the loading more evenly, the valve plate is less susceptible to deformation and the thickness of the valve plate can be reduced. This means that costs can be saved.

Preferred features of the invention are set out in the dependent Claims.

Embodiments of the invention will now be described by way of example and with reference to the accompanying drawings in which:-

Figure 1 is a section through a pump in accordance with the present invention;
Figure 2 is a section through Y-Y of the pump shown in Figure 1 and schematically showing a feed path for oil;
Figure 3 is an exploded perspective view showing a valve plate with four conventional loading pistons;
Figure 4 is a valve plate in accordance with the in combination with a loading piston according to a the invention;
Figure 5 is a perspective view of a swashplate;
Figure 6 is a perspective view of a cylinder block; and
Figures 7a and 7b are side and top views,

respectively, of a conventional floating cylinder block type of axial piston pump.

The general construction of the pump according to the present invention is the same as that of the conventional pump described above.

As can be seen from Figures 1 and 2, the pump comprises a drive shaft 2 which is fitted with a cylinder block 4. The cylinder block 4 is keyed to the said drive shaft 2 by means of a portion 7 of the drive shaft 2 which is generally square in cross-section and fits within a similarly profiled recess in the cylinder block 4. The cylinder block 4 is fixed to the drive shaft 2 in such a manner that rotation of the drive shaft 2 causes the cylinder block 4 to rotate. The drive shaft is supported by bearings 3 and 5 to facilitate rotation. The cylinder block 4 is fitted with nine pistons 6a - 6i.

Each piston is reciprocally movable in a direction parallel to the axis of rotation of the cylinder block assembly. A ball 8a - 8e is provided at the end of each piston and is received within a socket in a respective slipper pad 10a - 10e.

A swashplate 12 is provided within a swashplate cradle 14. The swashplate 12 has a curved back 16, which is part-circular in profile. The swashplate cradle 14 is provided with a swashplate seating surface 18 which is curved to the same degree as the rear of the swashplate 16. This allows the swashplate to swivel within the swashplate cradle 14.

During use, the swashplate 12 will be positioned within the swashplate cradle 14 with its load face 20 inclined such that a normal to the load face 20 is at an angle with the rotational axis of the drive shaft 2.

The angle of inclination of the swashplate 12 can be adjusted by means of a pair of control pistons (not completely shown) which move an arm 24 which is received within the swashplate 12. The angle of inclination of the swashplate is adjusted by means of the control pistons 22 which move the arm, thereby moving the swashplate. The direction of movement of the pistons 22 is into and out of the page as seen in Figure 1.

The rotation of the cylinder block 4 causes the pistons 6a - 6i to reciprocate as the piston slippers 10a - 10i act against the load face of the swashplate 12.

A valve plate 26 is provided at the other end of the cylinder block 4.

The valve plate 26 is loaded against the valve face of the cylinder block by four loading pistons 30a-30d. These pistons 30a-30d serve to prevent separation of the valve plate from the cylinder block valve face, thus minimising the loss of pressurized fluid into the pump casing. Each piston is provided with a seal 31a-31d about its perimeter.

The valve plate is provided with a kidney-shaped

inlet port 28 and two kidney-shaped outlet ports 29a and 29b.

A kidney-shaped recess is provided on the face 52 of the valve plate 26 which addresses the cylinder block. This recess communicates with the outlet ports 29a and 29b.

During use, reciprocation of the pistons causes oil to be drawn into the cylinder via the kidney-shaped inlet port 28 and the kidney-shaped slots 27a-27i in the valve face of the cylinder block. The oil is discharged via the kidney slots 27a-27i, the valve plate outlet ports 29a-29b, the loading pistons 30a-30d and finally an outlet port 25 in the cover.

A spiral groove bearing 50 is provided in a peripheral region of the cylinder block facing face 52 of the valve plate 26.

The spiral groove bearing 50 is formed from a plurality of grooves 54, which are formed so as to spiral inwardly from the periphery of the cylinder block facing face 52 of the valve plate towards the centre of this face 52.

Because the valve plate is held stationary relative to the rotating cylinder block during use , oil is driven into the grooves of the spiral groove bearing 50 and creates a hydrodynamic pressure. This provides a self-compensating effect and significantly reduces the risk of seizure. This arrangement enables the valve plate 26 to be loaded more heavily, thereby reducing leakage.

In accordance with the invention the four conventional valve plate loading pistons 30a - 30d are replaced with a single kidney-shaped piston 60. This can be seen in Figure 4.

The piston 60 comprises six outlet apertures 62a - 62f. These are aligned with six similarly sized and shaped outlet apertures 64a - 64f provided in a single kidney-shaped outlet port 66 of the valve plate 26. During operation of the pump, oil can escape by means of the outlet apertures 64a - 64f and subsequently on out through the outlet apertures 62a - 62f in the piston 60. The kidney-shaped inlet port of the valve plate 26 is identical to that of the conventional valve plate 26.

The kidney shaped piston 60 is fitted with a seal 61 about its perimeter; this corresponds to the seals 31a-31d of the prior art loading pistons.

Preferably, the kidney-shaped piston 60 will be used in conjunction with a spiral groove bearing 50, but it will operate successfully without the presence of such a spiral groove bearing.

If desired, the valve plate 26 plus loading piston 60 could be manufactured as a single integral component.

In order to facilitate adjustment of the swashplate 12 within the swashplate cradle 14, a pair of hydrostatic bearings 70 and 72 are provided in the curved surface 16 of the swashplate 12. This can best be seen from Figure 5. These bearings are fed with oil at pump outlet pressure.

The high pressure oil is supplied to the hydrostatic bearings 70 and 72 from the outlet port via openings provided in the nine pumping pistons 6a - 6i, through holes in the respective slipper pads 10a - 10i and via a feed hole 80 which extends through the wearplate 13 and the swashplate 12. The feed hole 80 directly feeds hydrostatic bearing 72. Hydrostatic bearing 70 is fed by means of a drilling 82 (shown in Figure 1 and schematically in Figure 5) in the swashplate cradle 14. Drilling 82 connects the two bearings 70 and 72. An orifice 83 is fitted in the drilling 80 to control the pressure at the bearings and limit the leakage rate.

The position of feed hole 80 relative to the outset port will determine the pressure of the oil supplied to the bearings. For maximum pressure at the hydrostatic bearings 70, 72, the feed hole and outlet port would need to be aligned.

Each time a slipper pad passes across the feed hole 80 in the wearplate 13, a pulse of high pressure oil is fed to the hydrostatic bearings. This can be seen schematically in Figure 6.

This arrangement reduces the complexity of machining components to provide the oil supply and thereby reduces the cost of the pump. It also provides a self-cleaning action for the control orifice 83, reduces fiction between swashplate 12 and cradle 14 and minimises leakage.

The invention could be incorporated in the hydraulic motor variant of the pump. When applying the arcuate loading piston principle to motors it will be necessary to provide two loading pistons, one adjacent to the supply port (equivalent to the pump's high pressure outlet port) and the second adjacent to the return port (equivalent to the pump's low pressure inlet port). The fitting of two pistons permits rotation in either the clockwise or anit-clockwise direction.

Upon making reference to the foregoing description, which is given by way of illustrative example only, many further modifications and adaptations will suggest themselves to those versed in the art. The scope of the present invention is not intended to be limited to exclude such modifications and adaptations.

Claims

1. An axial piston pump comprising a drive shaft (2), a cylinder block (4) fixed to, and rotatable with, the drive shaft (2), a plurality of first pistons (6a-6i) provided within the cylinder block (4), a swashplate (12) situated at one axial end of the cylinder block (4) for causing reciprocation of the pistons (6a-6i) when the said cylinder block (4) is rotated, and an axially moveable valve plate (26) situated at a second axial end of the cylinder block (4) and held stationary relative to the direction of rotation of the cylinder block (4) and urged against the said second end of the cylinder block (4) to form a hydrostatic seal between the cylinder block (4) and a bearing face (52) of the said valve plate (26) which address-

es the cylinder block, wherein the valve plate (26) is urged against the cylinder block (4) by means of a second piston (60), the said second piston (60) having a load face which is axially aligned with a portion of the said bearing face (52) of the valve plate; characterised in that the said load face of second piston (60) is arcuate.

2. An axial piston pump according to Claim 1, wherein the second piston (60) has a kidney-shaped load face.

3. An axial piston pump according to Claim 1 or 2, wherein the second piston (60) comprises a plurality of outlet apertures (62a-62f); each aperture (62a-62f) being aligned with a respective similarly configured outlet aperture (64a-64f) in the valve plate (26).

4. An axial piston pump according to any preceding Claim, wherein the valve plate (26) and second piston (60) are integrally formed.

5. An axial piston pump according to any preceding claim further characterised in that a spiral groove bearing (50) is provided between the valve plate (26) and the cylinder block (4).

6. An axial piston pump according to Claim 5 wherein grooves (54) of the spiral groove bearing (50) are provided in the valve plate (26).

7. An axial piston pump according to Claim 5, wherein grooves of the spiral groove bearing (50) are provided in the cylinder block (4).

8. An axial piston pump according to Claim 5,6,7, wherein the spiral groove bearing (50) comprises a plurality of spirally configured grooves.

9. An axial piston pump according to any one of Claims 5 to 7, wherein the spiral groove bearing is formed from a plurality of straight grooves.

10. An axial piston pump according to any one of Claims 5 to 9, wherein the grooves (54) forming the spiral groove bearing (50) are very shallow.

11. An axial piston pump according to any preceding claim wherein; the said swashplate (12) is provided with a curved back, the curved back being seated within a curved recess in a swashplate cradle (14), and the said swashplate (12) being capable of swivelling within the said recess (14); further characterised in that a hydrostatic bearing (70,72) is formed between the said curved back of the swashplate (12) and the curved recess of the swashplate cradle (14), and high pressure oil is supplied to the said hydrostatic bearing (70,72) via a passage provided in at least one of the said pistons and via a hole (80) provided in the body of the said swashplate (12).

12. An axial piston pump according to Claim 11, wherein a pair of hydrostatic bearings (70,72) are provided between the swashplate back and the swashplate cradle.

13. An axial piston pump according to Claim 12, wherein a first of the hydrostatic bearings (72) is fed directly by means of the said hole (80) provided in the swashplate (12), and the other (70) is fed via the first hydrostatic bearing (72) and via a passage (82) provided in the body of the swashplate cradle (14), which passage (82) links the two bearings (70,72).

14. An axial piston pump according to any one of Claims 11 to 12, further comprising a control orifice (83) provided in the said hole (80) in the swashplate (12) for modulating the pressure at the hydrostatic bearing or bearings (70,72).

15. An axial piston pump according to any one of Claims 11 to 14, wherein each of the said pistons (6a-6i) comprises a hole for allowing oil to be fed to the swashplate (12).

16. An axial piston pump according to Claim 15, wherein the load surface of the swashplate is provided with a wear plate (13) upon which slippers (10a-10i), provided at the respective ends of the pistons (6a-6i) move; each slipper (10a-10i) comprising a passage to allow oil to escape from its respective piston (6a-6i), and the wear plate (13) comprising a passage which communicates with the hole (80) in the swashplate (12).

Patentansprüche

1. Axialkolbenpumpe, die aufweist: eine Antriebswelle (2), einen Zylinderblock (4), der an der Antriebswelle (2) befestigt und mit dieser drehbar ist, eine Vielzahl von ersten Kolben (6a-6i), die innerhalb des Zylinderblockes (4) vorhanden sind, eine Taumelscheibe (12), die sich an einem axialen Ende des Zylinderblockes (4) befindet, um die Hin- und Herbewegung der Kolben (6a-6i) hervorzurufen, wenn der Zylinderblock (4) gedreht wird, und eine axial bewegliche Ventilplatte (26), die sich an einem zweiten axialen Ende des Zylinderblockes (4) befindet und relativ zur Drehungsrichtung des Zylinderblockes (4) stationär gehalten und gegen das zweite Ende des Zylinderblockes (4) gedrückt wird, um eine hydrostatische Abdichtung zwischen dem Zylinderblock (4) und einer tragenden Fläche (52) der Ventilplatte (26) zu bilden, die zum Zylinder-

block gerichtet ist, wobei die Ventilplatte (26) gegen den Zylinderblock (4) mittels eines zweiten Kolbens (60) gedrückt wird, und wobei der zweite Kolben (60) eine Lastfläche aufweist, die axial mit einem Abschnitt der tragenden Fläche (52) der Ventilplatte ausgerichtet ist; dadurch gekennzeichnet, daß die Lastfläche des zweiten Kolbens (60) bogenförmig ist.

2. Axialkolbenpumpe nach Anspruch 1, bei der der zweite Kolben (60) eine nierenförmige Lastfläche aufweist.

3. Axialkolbenpumpe nach Anspruch 1 oder 2, bei der der zweite Kolben (60) eine Vielzahl von Austrittsöffnungen (62a-62f) aufweist; wobei jede Öffnung (62a-62f) mit einer entsprechenden gleichermaßen gestalteten Austrittsöffnung (64a-64f) in der Ventilplatte (26) ausgerichtet ist.

4. Axialkolbenpumpe nach einem der vorhergehenden Ansprüche, bei der die Ventilplatte (26) und der zweite Kolben (60) in einem Stück hergestellt sind.

5. Axialkolbenpumpe nach einem der vorhergehenden Ansprüche, die außerdem dadurch gekennzeichnet ist, daß zwischen der Ventilplatte (26) und dem Zylinderblock (4) ein Spiralrillenlager (50) vorhanden ist.

6. Axialkolbenpumpe nach Anspruch 5, bei der die Rillen (54) des Spiralrillenlagers (50) in der Ventilplatte (26) vorhanden sind.

7. Axialkolbenpumpe nach Anspruch 5, bei der die Rillen des Spiralrillenlagers (50) im Zylinderblock (4) vorhanden sind.

8. Axialkolbenpumpe nach Anspruch 5, 6, 7, bei der das Spiralrillenlager (50) eine Vielzahl von spiralförmig gestalteten Rillen aufweist.

9. Axialkolbenpumpe nach einem der Ansprüche 5 bis 7, bei der das Spiralrillenlager aus einer Vielzahl von geradlinigen Rillen gebildet wird.

10. Axialkolbenpumpe nach einem der Ansprüche 5 bis 9, bei der die Rillen (54), die das Spiralrillenlager (50) bilden, sehr flach sind.

11. Axialkolbenpumpe nach einem der vorhergehenden Ansprüche, bei der die Taumelscheibe (12) mit einer gekrümmten Rückseite versehen ist, wobei die gekrümmte Rückseite innerhalb einer gekrümmten Aussparung in einer Taumelscheibenwiege (14) sitzt, und wobei sich die Taumelscheibe (12) innerhalb der Aussparung (14) drehen kann; außerdem dadurch gekennzeichnet, daß ein hydrostatisches Lager (70, 72) zwischen der gekrümmten Rückseite der Taumelscheibe (12) und der gekrümmten Aussparung der Taumelscheibenwiege (14) gebildet wird, und daß Hochdrucköl dem hydrostatischen Lager (70, 72) über einen Kanal, der in mindestens einem der Kolben vorhanden ist, und über eine Loch (80) zugeführt wird, das im Körper der Taumelscheibe (12) vorhanden ist.

12. Axialkolbenpumpe nach Anspruch 11, bei der ein Paar hydrostatische Lager (70, 72) zwischen der Taumelscheibenrückseite und der Taumelscheibenwiege vorhanden ist.

13. Axialkolbenpumpe nach Anspruch 12, bei der ein erstes hydrostatisches Lager (72) direkt mittels des in der Taumelscheibe (12) vorhandenen Loches (80) versorgt wird, und das andere (70) über das erste hydrostatische Lager (72) und über einen im Körper der Taumelscheibenwiege (14) vorhandenen Kanal (82), wobei der Kanal (82) die zwei Lager (70, 72) verbindet.

14. Axialkolbenpumpe nach einem der Ansprüche 11 bis 12, die außerdem eine Steueröffnung (83) aufweist, die im Loch (80) in der Taumelscheibe (12) für das Abstimmen des Druckes im hydrostatischen Lager oder den Lagern (70, 72) vorhanden ist.

15. Axialkolbenpumpe nach einem der Ansprüche 11 bis 14, bei der jeder Kolben (6a-6i) ein Loch aufweist, um die Zuführung von Öl zur Taumelscheibe (12) zu gestatten.

16. Axialkolbenpumpe nach Anspruch (15), bei der die Lastfläche der Taumelscheibe mit einer Verschleißscheibe (13) versehen ist, auf der sich die Gleitstücke (10a-10i) bewegen, die an den entsprechenden Enden der Kolben (6a-6i) vorhanden sind; wobei jedes Gleitstück (10a-10i) einen Kanal aufweist, damit das Öl aus seinem entsprechenden Kolben (6a-6i) austreten kann, und wobei die Verschleißscheibe (13) einen Kanal aufweist, der eine Verbindung mit dem Loch (80) in der Taumelscheibe (12) zeigt.

Revendications

1. Pompe à pistons axiaux comprenant un arbre d'entraînement (2), un bloc-cylindre (4) fixé à et pouvant tourner avec l'arbre d'entraînement (2), plusieurs premiers pistons (6a-6i) situés dans le bloc-cylindre (4), une plaque basculante (12) située à une extrémité axiale du bloc-cylindre (4) pour assurer le mouvement alternatif des pistons (6a-6i) quand ledit bloc-cylindre (4) est en rotation, et un plateau de distribution mobile axialement (26) situé à une

deuxième extrémité axiale du bloc-cylindre (4), maintenu fixe par rapport à la direction de rotation du bloc-cylindre (4) et poussé contre la deuxième extrémité du bloc-cylindre (4) pour former un joint hydrostatique entre le bloc-cylindre (4) et une face portante (52) dudit plateau de distribution (26) tourné vers le bloc-cylindre, dans laquelle le plateau de distribution (26) est poussé contre le bloc-cylindre (4) au moyen d'un deuxième piston (60), le deuxième piston (60) ayant une face de charge qui est alignée axialement avec une partie de ladite face portante (52) du plateau de distribution; caractérisée en ce que ladite face de charge du deuxième piston (60) a une forme incurvée.

2. Pompe à pistons axiaux selon la revendication 1, dans laquelle le deuxième piston (60) a une face de charge réniforme.

3. Pompe à pistons axiaux selon la revendication 1 ou 2, dans laquelle le deuxième piston (60) comprend plusieurs ouvertures de sortie (62a-62f); chaque ouverture (62a-62f) étant alignée avec une ouverture de sortie (64a-64f) de forme semblable dans le plateau de distribution (26).

4. Pompe à pistons axiaux selon l'une quelconque des revendications précédentes, dans laquelle le plateau de distribution (26) et le deuxième piston (60) sont formés d'une seule pièce.

5. Pompe à pistons axiaux selon l'une quelconque des revendications précédentes, caractérisée en outre en ce qu'un palier à rainures spiralées (50) est disposé entre le plateau de distribution (26) et le bloc-cylindre (4).

6. Pompe à pistons axiaux selon la revendication 5, dans laquelle les rainures (54) du palier à rainures spiralées (50) sont disposées dans le plateau de distribution (26).

7. Pompe à pistons axiaux selon la revendication 5, dans laquelle les rainures du palier à rainures spiralées (50) sont disposées dans le bloc-cylindre (4).

8. Pompe à pistons axiaux selon les revendications 5, 6 et 7 dans laquelle le palier à rainures spiralées (50) comprend plusieurs rainures en forme de spirale.

9. Pompe à pistons axiaux selon l'une quelconque des revendications 5 à 7, dans laquelle le palier à rainures spiralées comporte plusieurs rainures droites.

10. Pompe à pistons axiaux selon l'une quelconque des revendications 5 à 9, dans laquelle les rainures (54) formant le palier à rainures spiralées (50) sont très peu profondes.

11. Pompe à pistons axiaux selon l'une quelconque des revendications précédentes, dans laquelle ladite plaque basculante (12) comporte un dos incurvé, le dos incurvé reposant dans un évidement incurvé dans un berceau de plaque basculante (14) et ladite plaque basculante (12) étant capable de pivoter dans ledit évidement (14); caractérisée en outre en ce qu'un palier hydrostatique (70, 72) est formé entre ledit dos incurvé de la plaque basculante (12) et l'évidement incurvé du berceau de plaque basculante (14) et que de l'huile sous haute pression est introduite dans ledit palier hydrostatique (70, 72) par un passage disposé dans au moins l'un desdits pistons et en passant par un trou (80) pratiqué dans le corps de ladite plaque basculante (12).

12. Pompe à pistons axiaux selon la revendication 11, dans laquelle il est prévu une paire de paliers hydrostatiques (70, 72) entre le dos de la plaque basculante et le berceau de la plaque basculante.

13. Pompe à pistons axiaux selon la revendication 12, dans laquelle le premier desdits paliers hydrostatiques (72) est alimenté directement par ledit trou (80) pratiqué dans la plaque basculante (12) et l'autre (70) est alimenté en passant par le premier palier hydrostatique (72) et par un passage (82) pratiqué dans le corps du berceau de la plaque basculante (14), ledit passage (82) connectant les deux paliers (70, 72).

14. Pompe à pistons axiaux selon l'une quelconque des revendications 11 à 12, comprenant en outre un orifice de réglage (83) réalisé dans ledit trou (80) dans la plaque basculante (12) pour moduler la pression du ou des palier(s) hydrostatique(s) (70, 72).

15. Pompe à pistons axiaux selon l'une quelconque des revendications 11 à 14, dans laquelle chacun desdits pistons (6A-6i) comprend un trou pour permettre l'amenée de l'huile à la plaque basculante (12).

16. Pompe à pistons axiaux selon la revendication 15, dans laquelle la surface portante de la plaque basculante comporte une plaque d'usure (13) sur laquelle se déplacent des coulisseaux (10a-10i) disposés aux extrémités correspondantes des pistons (6a-6i), chaque coulisseau (10a-10i) comprenant un passage pour permettre à l'huile de s'échapper de son piston correspondant (6a-6i) et la plaque d'usure (13) comprenant un passage communiquant avec le trou (80) dans la plaque basculante (12).

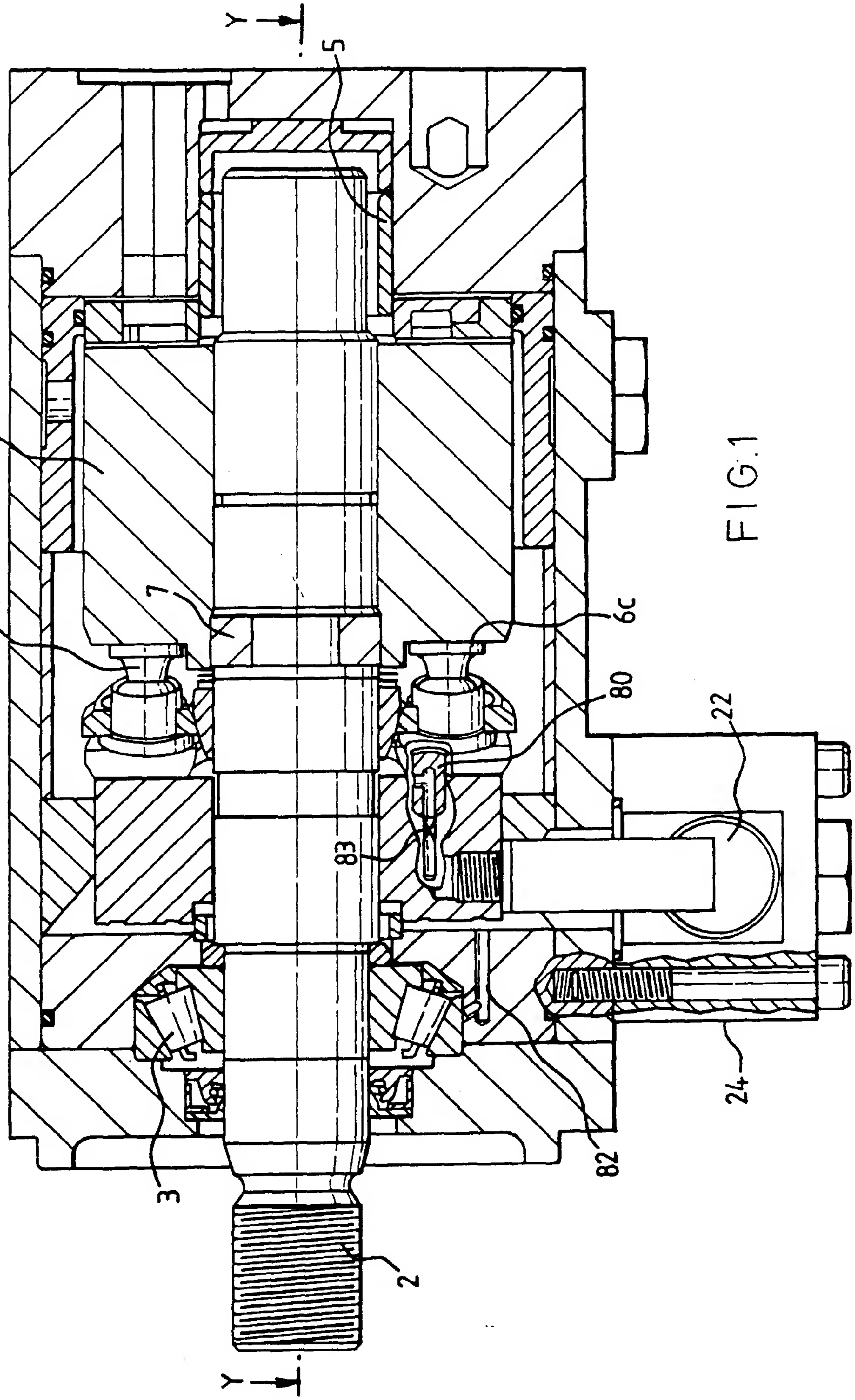


FIG.1

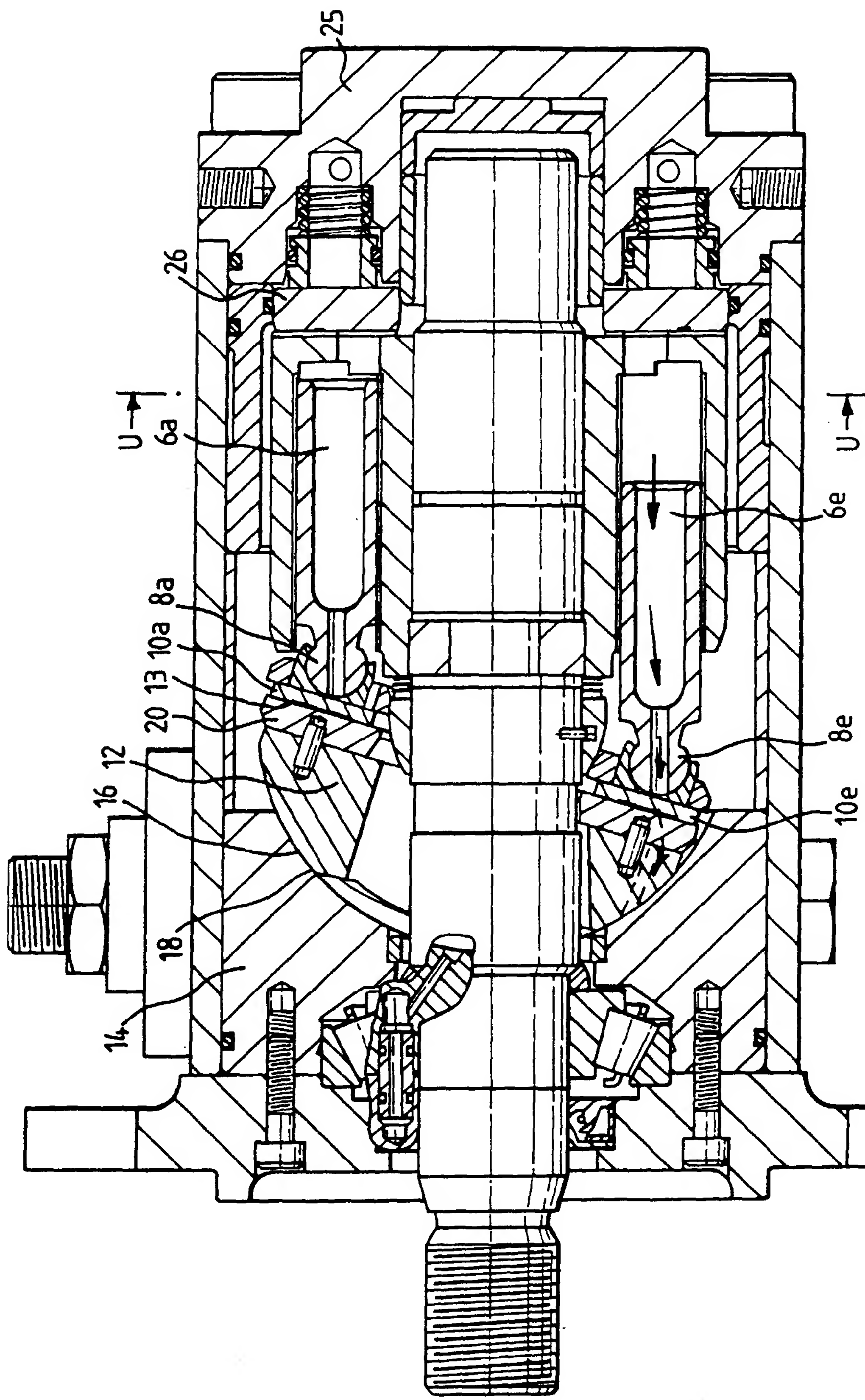


FIG.2

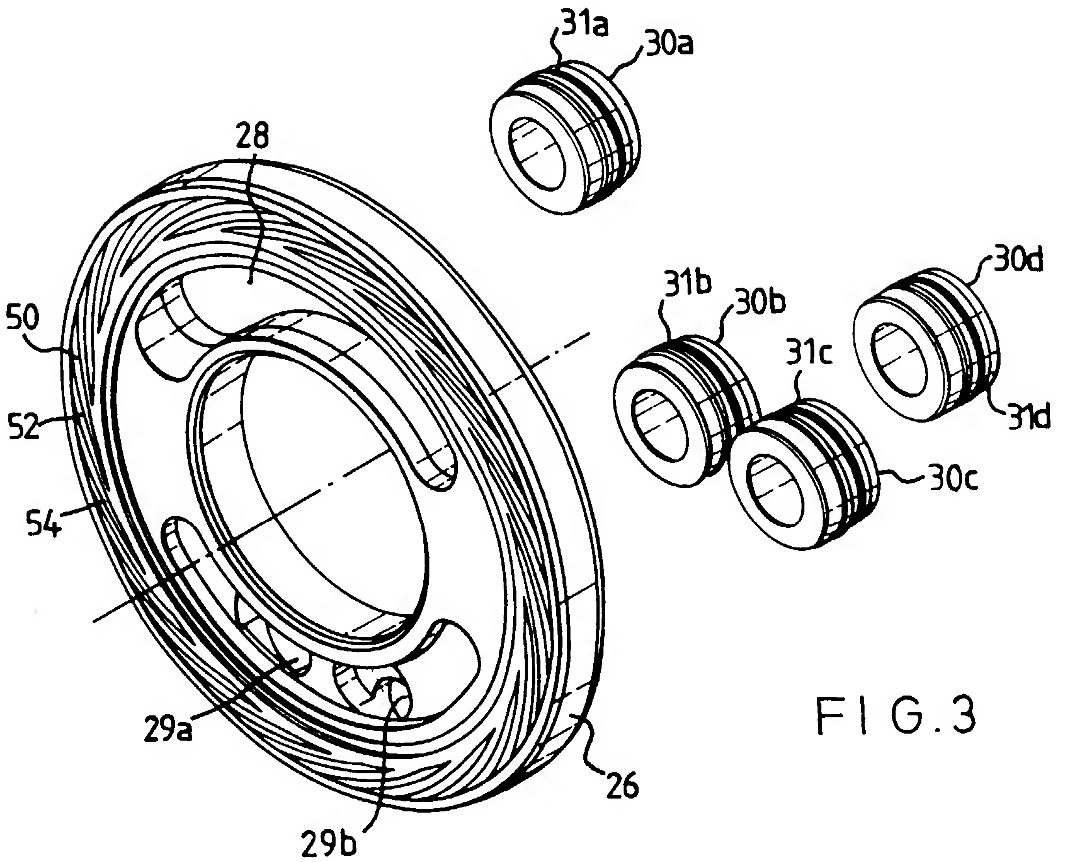

31a
30a
28
31b
30b
30d
50
31c
52
31d
30c
54
29a
26
29b

FIG.3

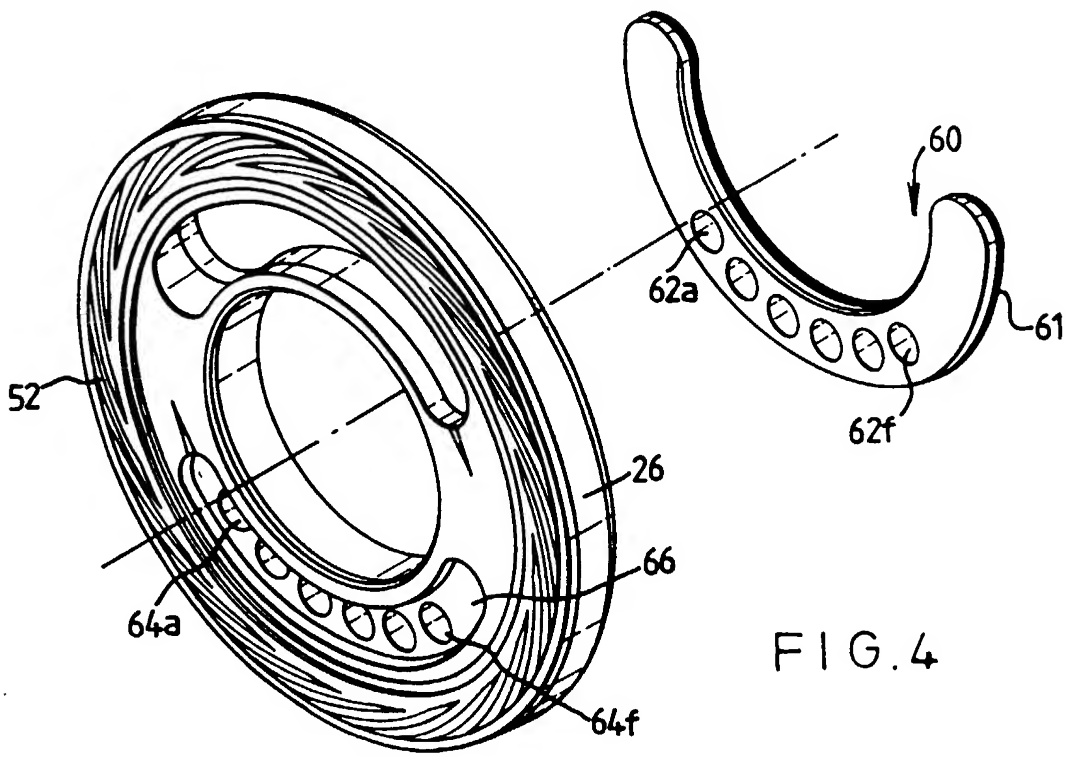
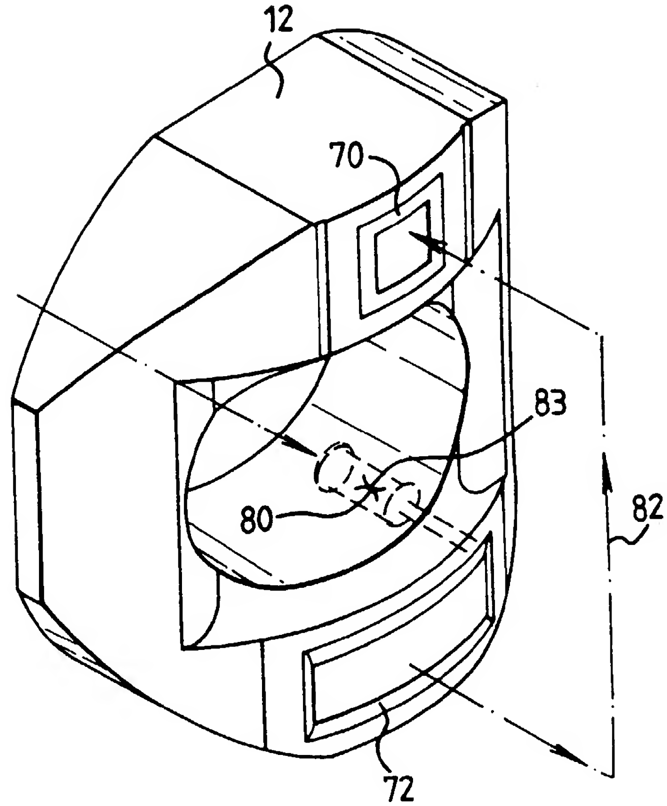
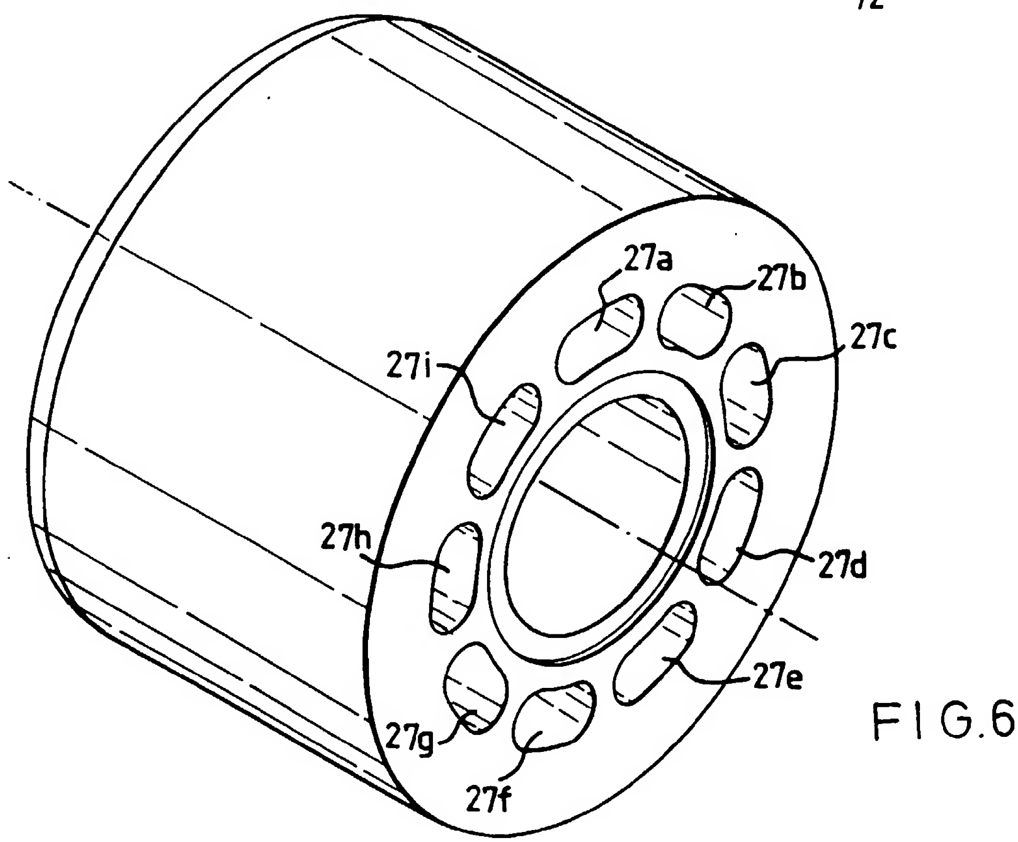

60
62a
61
52
62f
26
66
64a
64f

FIG.4



F I G.5



F I G.6

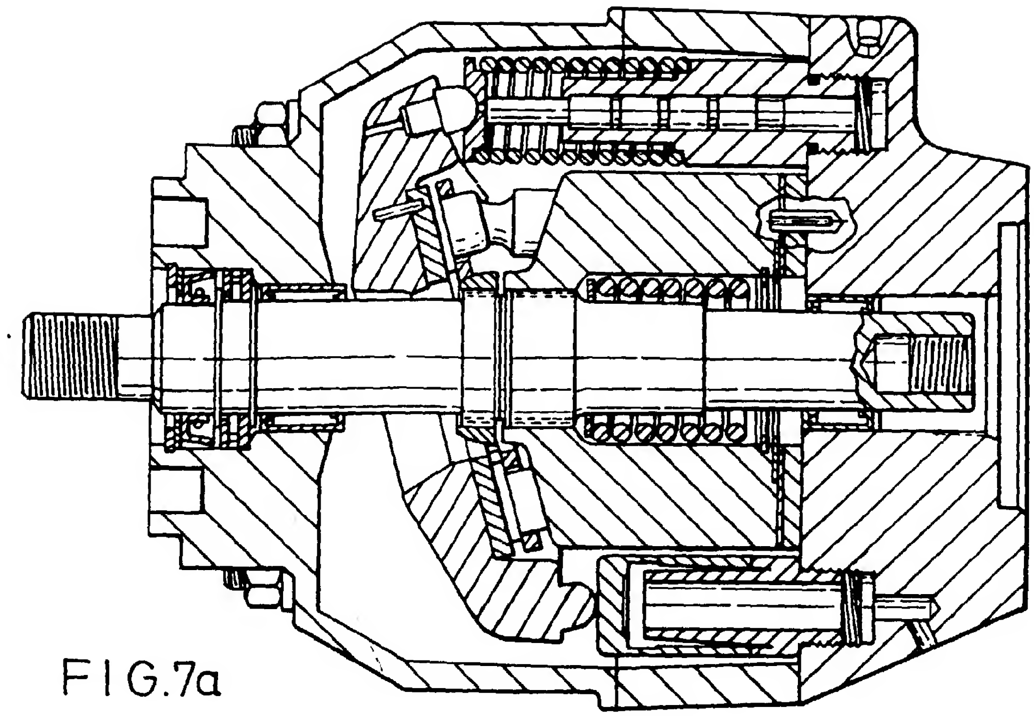


FIG.7a

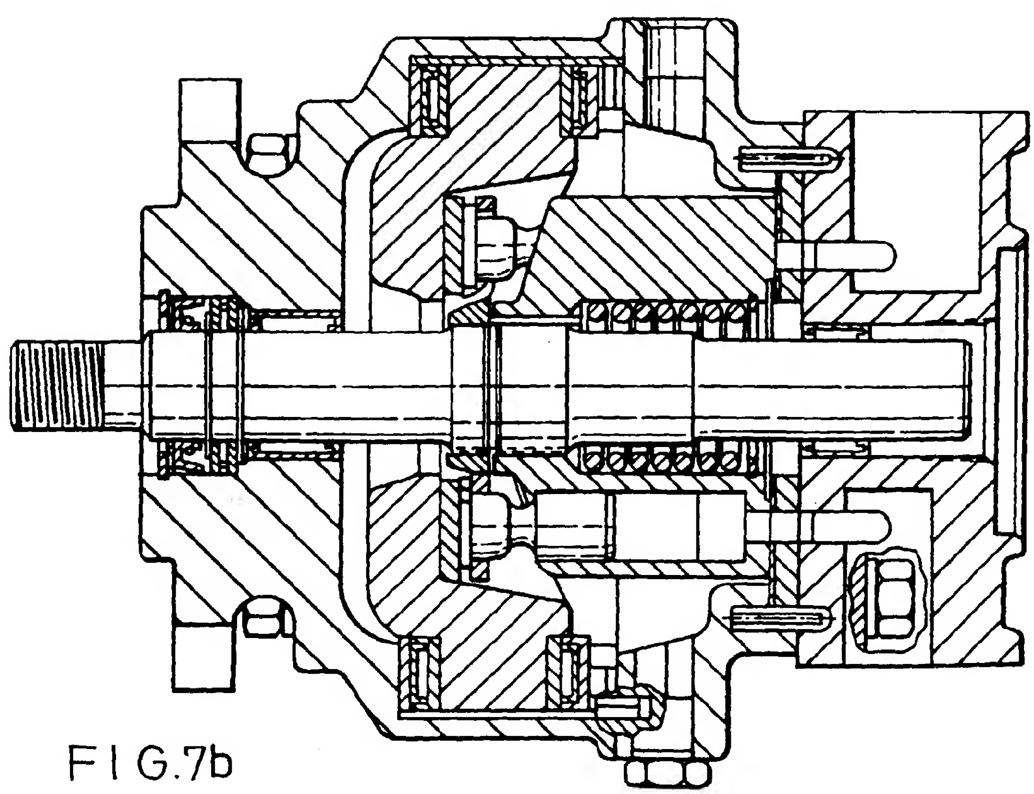


FIG.7b